CONTENTS

PREFACE

A MOLECULAR PHENOMENON

It is commonplace, almost banal, to say that science has made great strides in understanding nature. The laws of physics are now so well understood that space probes fly unerringly to photograph worlds billions of miles from earth. Computers, telephones, electric lights, and untold other examples testify to the mastery of science and technology over the forces of nature. Vaccines and high-yield crops have stayed the ancient enemies of mankind, disease and hunger—at least in parts of the world. Almost weekly, announcements of discoveries in molecular biology encourage the hope of cures for genetic diseases and more.

Yet understanding how something works is not the same as understanding how it came to be. For example, the motions of the planets in the solar system can be predicted with tremendous accuracy; however, the origin of the solar system (the question of how the sun, planets, and their moons formed in the first place) is still controversial.[1] Science may eventually solve the riddle. Still, the point remains that understanding the origin of something is different from understanding its day-to-day workings.

Science's mastery of nature has led many people to presume that it can—indeed, must—also explain the origin of nature and life. Dar-

CHAPTER 1

LILLIPUTIAN BIOLOGY

THE LIMITS OF AN IDEA

This book is about an idea—Darwinian evolution—that is being pushed to its limits by discoveries in biochemistry. Biochemistry is the study of the very basis of life: the molecules that make up cells and tissues, that catalyze the chemical reactions of digestion, photosynthesis, immunity, and more.[1] The astonishing progress made by biochemistry since the mid-1950s is a monumental tribute to science's power to understand the world. It has brought many practical benefits in medicine and agriculture. We may have to pay a price, though, for our knowledge. When foundations are unearthed, the structures that rest on them are shaken; sometimes they collapse. When sciences such as physics finally uncovered their foundations, old ways of understanding the world had to be tossed out, extensively revised, or restricted to a limited part of nature. Will this happen to the theory of evolution by natural selection?

Like many great ideas, Darwin's is elegantly simple. He observed that there is variation in all species: some members are bigger, some smaller, some faster, some lighter in color, and so forth. He reasoned that since limited food supplies could not support all organisms that

are born, the ones whose chance variation gave them an advantage in the struggle for life would tend to survive and reproduce, outcompeting the less favored ones. If the variation were inherited, then the characteristics of the species would change over time; over great periods, great changes might occur.

For more than a century most scientists have thought that virtually all of life, or at least all of its most interesting features, resulted from natural selection working on random variation. Darwin's idea has been used to explain finch beaks and horse hoofs, moth coloration and insect slaves, and the distribution of life around the globe and through the ages. The theory has even been stretched by some scientists to interpret human behavior: why desperate people commit suicide, why teenagers have babies out of wedlock, why some groups do better on intelligence tests than other groups, and why religious missionaries forgo marriage and children. There is nothing—no organ or idea, no sense or thought—that has not been the subject of evolutionary rumination.

Almost a century and a half after Darwin proposed his theory, evolutionary biology has had much success in accounting for patterns of life we see around us. To many, its triumph seems complete. But the real work of life does not happen at the level of the whole animal or organ; the most important parts of living things are too small to be seen. Life is lived in the details, and it is molecules that handle life's details. Darwin's idea might explain horse hoofs, but can it explain life's foundation?

Shortly after 1950 science advanced to the point where it could determine the shapes and properties of a few of the molecules that make up living organisms. Slowly, painstakingly, the structures of more and more biological molecules were elucidated, and the way they work inferred from countless experiments. The cumulative results show with piercing clarity that life is based on *machines*—machines made of molecules! Molecular machines haul cargo from one place in the cell to another along "highways" made of other molecules, while still others act as cables, ropes, and pulleys to hold the cell in shape. Machines turn cellular switches on and off, sometimes killing the cell or causing it to grow. Solar-powered machines capture the energy of photons and store it in chemicals. Electrical machines

allow current to flow through nerves. Manufacturing machines build other molecular machines, as well as themselves. Cells swim using machines, copy themselves with machinery, ingest food with machinery. In short, highly sophisticated molecular machines control every cellular process. Thus the details of life are finely calibrated, and the machinery of life enormously complex.

Can all of life be fit into Darwin's theory of evolution? Because the popular media likes to publish exciting stories, and because some scientists enjoy speculating about how far their discoveries might go, it has been difficult for the public to separate fact from conjecture. To find the real evidence you have to dig into the journals and books published by the scientific community itself. The scientific literature reports experiments firsthand, and the reports are generally free of the flights of fancy that make their way into the spinoffs that follow. But as I will note later, if you search the scientific literature on evolution, and if you focus your search on the question of how molecular machines—the basis of life—developed, you find an eerie and complete silence. The complexity of life's foundation has paralyzed science's attempt to account for it; molecular machines raise an as-yet-impenetrable barrier to Darwinism's universal reach. To find out why, in this book I will examine several fascinating molecular machines, then ask whether they can ever be explained by random mutation/natural selection.

Evolution is a controversial topic, so it is necessary to address a few basic questions at the beginning of the book. Many people think that questioning Darwinian evolution must be equivalent to espousing creationism. As commonly understood, creationism involves belief in an earth formed only about ten thousand years ago, an interpretation of the Bible that is still very popular. For the record, I have no reason to doubt that the universe is the billions of years old that physicists say it is. Further, I find the idea of common descent (that all organisms share a common ancestor) fairly convincing, and have no particular reason to doubt it. I greatly respect the work of my colleagues who study the development and behavior of organisms within an evolutionary framework, and I think that evolutionary biologists have contributed enormously to our understanding of the world. Although Darwin's mechanism—natural selection working on variation—might explain many things, however, I do not believe it explains molecular life. I also do

The groundbreaking, "seminal work" (*Time*) on intelligent design that dares to ask, was Darwin wrong?

IN 1996, *Darwin's Black Box* helped to launch the intelligent design movement: the argument that nature exhibits evidence of design, beyond Darwinian randomness. It sparked a national debate on evolution, which continues to intensify across the country. From one end of the spectrum to the other, *Darwin's Black Box* has established itself as the key intelligent design text—the one argument that must be addressed in order to determine whether Darwinian evolution is sufficient to explain life as we know it.

In a major new Afterword for this edition, Behe explains that the complexity discovered by microbiologists has dramatically increased since the book was first published. That complexity is a continuing challenge to Darwinism, and evolutionists have had no success at explaining it. *Darwin's Black Box* is more important today than ever.

"An argument of great originality, elegance, and intellectual power. . . . No one can propose to defend Darwin without meeting the challenges set out in this superbly written and compelling book." —David Berlinski, author of *A Tour of the Calculus*

"Overthrows Darwin at the end of the twentieth century in the same way that quantum theory overthrew Newton at the beginning." —George Gilder in *National Review*

"[Behe] is the most prominent of the small circle of scientists working on intelligent design, and his arguments are by far the best known." —H. Allen Orr in *The New Yorker*

"When examined with the powerful tools of modern biology, but not with its modern prejudices, life on a biochemical level can be a product, Behe says, only of intelligent design. Coming from a practicing biologist . . . this proposition is close to heretical."
—*The New York Times Book Review*

fP FREE PRESS
Published by Simon & Schuster New York

Cover design by Marc J. Cohen
Cover photographs by Photonica (Eclipse)
and James Balog (Monkey/Man)

Register online at www.simonsays.com for more information on this and other great books.

03061500

U.S. $15.00
Can. $21.00

ISBN-13: 978-0-7432-9031-9
ISBN-10: 0-7432-9031-3

51500
9 780743 290319